constant tendency toward discharge, the not unlikely cause of the phenomena of epilepsy, seems easy of explanation; though a careful consideration of the investigations of Blyth,[1] to whom we owe the knowledge of the important fact that the specific pathological cerebral effect of plumbism is not merely a structural change, but one of composition not detectable by ordinary means of pathological research—that it consists in a chemical combination of the lead in the brain with the complicated nitrogenous and phosphorized brain-fats, forming a definite substitution-compound to lead cephalin, in which a molecule of hydrogen is replaced by one of lead.

If there be nothing in the character of seizure in certain cases of lead convulsions to differentiate them from the fits of ordinary epilepsy, and the common symptoms of plumbism, as is often the case, be so slight as to escape notice, the observer not being especially on the watch, errors in diagnosis may readily enough occur. The oversight would be, of course, the more venial if, with lack of unequivocal symptoms and presence of obscure and unusual source of poisoning, the case came under observation years after development of the seizures. In Case XV., had I not at the time it presented itself known of the common use of chrome-yellow by bakers, I should not, of course, have especially suspected lead as a causative factor, although the age at which the epilepsy appeared, with a negative history of syphilis, renal disease, and of trauma, would, naturally, have led to an inquiry in that direction. In Case XVI. the convulsions began at the age at which the development of epilepsy is more common. With an utter lack of the more usual symptoms of plumbism, lead-poisoning would not have been suspected as a cause of the convulsions had not the customary inquiries, in developing the history, into various points that might seem to bear on the case elicited the fact already stated regarding exposure to lead in an occupation most liable to originate severe constitutional symptoms. Even then a connection of cause and effect could have been little more than conjecture, had not further inquiry brought out the additional fact of not only origin of fits after exposure, but their cessation on abandoning work, and, again, their re-development with renewed exposure. Systemic intoxication in this case must have been unusually severe, unless a second source of poisoning, though not evident, was present; since, though he had been absent from his trade for a year or more, lead was repeatedly found in the urine,[2] and twice in large amount, as such things go, when potassium iodide was taken freely with the object of eliminating the metal from the tissues.

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[1] Journal of Mental Science, January, 1888.

[2] All the urine examinations for lead were made for me by Dr. Leffmann, to whom I am under many obligations for the same.

REVIEWS.

INVESTIGATIONS ON MICROSCOPIC FOAMS AND ON PROTOPLASM. Experiments and Observations Directed Toward a Solution of the Question of the Physical Conditions of the Phenomena of Life. By O. BÜTSCHLI, Professor of Zoölogy in the University of Heidelberg. Authorized translation by E. A. MINCHIN, B.A., Fellow of Merton College, Oxford. 8vo., pp. 340. Twelve lithograph plates. London: Adam & Charles Black, 1894.

IT is but the natural outcome of the development of the biologic sciences that extensive series of facts regarding the structure and phenomena of living organisms having been accumulated, biologists should more and more turn their attention to the explanation of these facts. It is likewise eminently proper that each factor in the complex phenomena of life should receive careful examination in the light of the exact sciences of mechanics, physics, and chemistry before the biologist shall be called upon to say how far these phenomena may be attributed to the laws of physics, and at what point, if at any, some peculiar form of energy is to be called in.

It is only by establishing upon an experimental basis the explanation of fact after fact, according to known laws, that those vital phenomena may be isolated which demand the existence of some as yet not understood form of energy.

Twenty years ago Houghton pointed out many new and interesting applications of exact mathematical science to the problems of molar movements in animals, and expressed as the result of his studies his belief in a process of evolution of higher from lower forms of existence, according to fixed laws. Marey, Cope, Ryder, and others have since contributed much to the understanding of the mechanical origin of the hard parts of organisms, through the action of interference energies—molecular and molar movements—such as the physical tensions inherent in protoplasm along with other colloid fluids, and the effect of such agencies as impact, friction, and strain. Ryder has grouped these so-called "*kinetogenic*" and "*statogenic*" movements under a general form of energy which he terms "*ergogenesis*."

The emanation of heat, light, and electricity from living organic bodies has received careful study at the hands of various physicists, and the catagenetic processes involved in the elaboration of the carbohydrates, waxes, oils, alkaloids, and proteids, forming the proximate constituents of plants, and of the various secretion and excretion products of animal katabolism, have received most exhaustive attention from the physiological chemist and spectroscopist.

In no case, however, have these researches eliminated the necessity of recognizing the existence of some anagenetic or growth-force, some "vital" upbuilding energy, such as Cope includes under the terms "*bathmism*" and "*emphytism*;" for example, such a force as is exhibited in the "antichemism" of plants, *i. e.*, the energy which is displayed by the elaboration of living from non living matter. This is a constructive or anagenetic process employing the energy derived from the heat and light of the sun. It is at first confined to the single individual (*auto-bathmogenic energy*), proceeding as a higher manifestation, to embryo-building, to the formation of secondary organisms like the parent (*emphytogenic energy*). But the vital phenomena, which are commonly regarded as inexplicable in terms of physics, go beyond the upbuilding of living from non-living matter and the multiplication of the resulting organisms. These latter exhibit on every hand the influence of a growth-energy which is not exhausted by the formation and activity of the individual or species, but which tends constantly to a higher plane of structure and function through the subdivision and specialization of its action, due to special acquired arrangements and rearrangements of the molecules upon which it acts. This highest manifestation of growth-force is seen in the phenomena of evolution, and its various phases are marked by molecular attitudes or groupings, which remain unaltered so long as they keep well within the main axis or current of the growth-force.

It will be seen that there are two lines of biologic thought—the one dealing with a constantly growing list of structure and functional phenomena that may be accounted for under the laws of molecular and molar physics and chemistry; another constantly decreasing list of phenomena to be explained only upon the basis of some as yet not understood growth-force—the ultimate and essential force of life.

While man is constantly learning the properties, states, and relationships of matter which determine the possibility and degree in which this anagenetic force may manifest itself, he has never been able to imitate any of the anagenetic processes, and all attempts to demonstrate spontaneous generation of living organisms have been failures.

The gaze of the biologist, intent on discriminating between the essentially physical and mechanical processes of life and those requiring the action of a special growth-energy, is fixed steadfastly upon the living cell, and every contribution to our knowledge of the cell brings us to a better understanding of the nature and limitations of that growth-force which has, by one of our contemporaries, been deified as "Biologos."

The attitude toward these questions assumed by Prof. Otto Bütschli, than whom none is better fitted by training and experience to speak, is well defined in the following sentences from his masterly work, only recently made available to English readers: ". . . I am convinced that we shall get no farther in these matters by means of speculations upon attractions and contractions, or with the help of micellar and molecular theories; but that we must rather risk the attempt to advance upon the basis of the known phenomena of molecular physics. In any case, I think that by means of this work I shall establish the conviction that in living matter there are no mysterious forces at work, but only those which also prevail in the organic world" (p. 250).

Prof. Bütschli is well known as one of the most thorough students of the protozoa, living. For years he has been one of the most prolific contributors to our knowledge of protoplasmic organisms in their least differentiated forms, and the present work is an attempt to explain the structure and phenomena of living protoplasm on a rational basis capable of demonstration.

The work is divided into two parts, the first of which deals with the investigations upon oil foams and upon protoplasmic structures. The second part takes up the theory of the net-like or reticular structure of protoplasm, and ends with a most exhaustive summary of the divergent views.

It is impossible to present here any adequate idea of the interest with which the student of cell structure must read the accounts of Prof. Bütschli's success in manufacturing oil-lathers or foams,[1] small masses of which exhibit under the microscope the structure and behavior of protoplasm to a wonderful degree. His foam-drops show the alveolar structure of protoplasm, together with its cuticular layer, the granular appearance is imitated, and the granules stream about as in living protoplasm; they creep somewhat rapidly backward and forward under the cover-class; when free from pressure their activity is increased by warmth and electricity up to a certain point, and the direction of movement may be determined arbitrarily by the application of various stimuli to molecular activity, such as heat and substances possessing different surface tensions. The empty cells of thin sections of elder and sunflower pith, after being passed from absolute alcohol to chloroform, are filled with fine oil-foams, rendered transparent with glycerin, whereupon, "in successful preparations, it is then observed that the oil lather contained in each of the pith cells is in lively streaming which persists for hours." It is interesting to note that "nothing was ever observed of a rotational streaming such as occurs in vegetable cells;" the process observed was that commonly spoken of as circulation and so frequently demonstrated in the stamen hairs of tradescantia.

Nowhere is there available a more thorough digest of the conflicting views regarding the structure of protoplasm than is presented here. Only once or twice does Prof. Bütschli show any inclination to abandon the method of calm impersonal presentation, and show the fire of the advocate. Künstler seems to have aroused him considerably by criticisms of his previous comparisons of the structure of protoplasm with the structural relations of a foam, and Bütschli's retort is interesting as presenting his position:

"Any one who takes exception, at the outset, to all attempts to explain the various phenomena of life on the ground that such attempts are devoid of importance, because not made upon the living body or upon protoplasm, renounces at once all possibility of an explanation of these processes; he shows that he does not take their explanation seriously, but thinks it more correct to regard vital phenomena as the outcome of a secret and mystical cause which it is not permissible to touch upon. Whoever, on the other hand, does not share this point of view, will, as little as myself, be of the opinion that I had prepared living protoplasm by means of my experiments, but will admit that bodies were successfully manufactured which not only possess a great similarity to living protoplasm in their structural relations, but also offer certain peculiarities which hitherto were only to be observed in the same manifestation and for the same length of time in living protoplasm. To bring these results to bear upon the explanation of the phenomena exhibited by living protoplasm seems to me not only permissible but even imperative.

"Now, Künstler explains protoplasm not only as a living, but also as a 'highly structured' substance. In so far as this statement has reference to structural relations actually observed, and not to such as are supposed to be hidden from us, and to be necessarily connected with the mysterious life of this substance, I can by no means agree with it. Protoplasm, as far as our knowledge extends, is in no way more highly structured than foams artificially manufactured by me; and if it must of necessity possess a very high degree of complexity, it may be confidently predicted that this complexity is to be sought in the province of chemistry, as I have already attempted to explain elsewhere (1891). Finally, according to Künstler, protoplasm must be 'the result of a special development, which can have nothing in common with the mixtures prepared by me.' Now, I think that Künstler will find it difficult to reply if he were asked for a more precise account of this special mode of development, of which protoplasm is the result. I regret to say that I, at least, know nothing definite concerning any developmental history of protoplasm, although I am, of course, greatly interested in it. So far as I have heard, there has been much talk about the growth of protoplasm, and some hypotheses concerning it have been put forward, which, however, only deal with the mode in which complete molecules or micellæ of protoplasm are added to those already in existence; but, as I have said, I know nothing of any special mode of development of protoplasm which could be adduced in opposition to the validity of my attempts to explain certain phenomena of protoplasm."

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[1] Made of olive-oil, potash, soap, and glycerin.

Prof. Bütschli does not attempt to do more than he here indicates, "explain certain phenomena of protoplasm," and although the artificial imitation of the radial appearance in cell division and of karyokinetic figures strikes one as prophetic of what may yet be learned by the study of "the interaction of physical and chemical forces under definite conditions," there undoubtedly still remains a wide field for the "biologos" or bathmic forces of the biologic metaphysician.

In dealing with the subject of surface tensions we are surprised to note that Prof. Bütschli makes no reference to the interesting studies of Reinold and Rücker,[1] especially the paper "On the Relations Between Thickness and the Surface Tension of Liquid Films," although he frequently refers to Plateau and Van der Mensbrugghe, whose work is corrected and supplemented by that of Reinold and Rücker. The latter investigators show, by direct comparison of the tension of thick and thin films over a range of thickness extending from 1350 to 12 millionths of a micro-millimetre, that there is no evidence that any change in surface tension is dependent on the thickness of the film. In connection with the degree to which pseudopodia may be extended, Bütschli offers no suggestion, except the general statement that the currents in an amœba run "just as if an extension current existed as the result of the surface tension being diminished at the anterior end." This is in accordance with the law that the difference in surface tension in two parts of the same film must produce motion; but the distributing factor remaining fixed, what is to limit the forward motion? It seems that the increased viscosity,[2] due to stretching the cuticular layer; the fact that the thickness and surface tension of films appear to be affected by the nature of the gas with which the films are in contact; and finally, the fact noted by Sir W. Thompson, that a film is cooled as it is extended, may all have some effect in putting a stop to further changes in surface tension at the anterior end of the moving amœba or elongating pseudopod, and consequently to their movements.

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[1] Philos. Trans., Lond. 1881, vol. 172; 1883, vol. 174; 1886, vol. 177.

[2] When the thickness of a film becomes less than twice the radius of molecular action its viscosity increases. The magnitude of the radius of molecular action would appear to be from 3½ to 7 millionths of a millimetre (micro-millimetres), judging from the fact that Reinold and Rücker show that the tension of a film, which is sensibly constant when the thickness exceeds 50 micro-millimetres, diminishes to a minimum, and begins to increase again when the thickness is diminished to from 14 to 7 micro-millimetres.

Not only does Bütschli show similarities in structure between his foam drops and protoplasm, but, after demonstrating "that the framework and the intervening substance of protoplasm must be fluid," as in his alveolated oil-lather drops, he goes on to point out the harmony of the investigations of Reinke and Rodeswald upon the enchylema squeezed out from *Æthalium septicum*, with his own conclusion, that the intrareticular substance must be interpreted as an alkaline watery solution; and he completes the chemical resemblance of his foams to living protoplasm by pointing out the probability that the foam-work substance of protoplasm is formed by a body which has arisen from a combination of albuminoid and fatty acid molecules, forming a body insoluble in water. The phenomena of chemotaxis as described by Metschnikoff and others would appear to have a direct bearing on this subject, but it receives no attention, although the much less important chemical hypothesis of Montgomery is referred to. C. S. D.

DERMATOLOGY: BEING VOLUME III. OF A SYSTEM OF GENITO-URINARY DISEASES, SYPHILOLOGY, AND DERMATOLOGY. By various authors. Edited by PRINCE A. MORROW, A.M., M.D. With illustrations. Pp. 976. New York: D. Appleton & Co., 1894.

THE contributors to this large, imposing, and valuable work on dermatology are writers well known to the profession in this department of medicine. New York City is represented by C. W. Allen, E. B. Bronson, G. T. Elliott, J. A. Fordyce, G. H. Fox, L. Heitzmann, G. T. Jackson, F. J. Leviseur, P. A. Morrow, H. G. Piffard, S. Pollitzer, and A. R. Robinson; Philadelphia, by M. B. Hartzell, H. W. Stelwagon, A. Van Harlingen, and E. J. Stout; Chicago, by J. N. Hyde and J. Zeissler; St. Louis, by W. A. Hardaway and C. F. Hersmann; New Orleans, by H. W. Blanc, I. Dyer, and R. Matas; Boston, by J. T. Bowen; Cleveland, by W. T. Corlett; Montreal, by F. G. Shepherd; and Toronto, by I. E. Graham. These names are all everywhere favorably known in connection with dermatology, and, as a matter of course, command a respectful hearing on the subjects discussed.

The scope of the work as planned by the accomplished editor is on broad lines, the subject-matter and its arrangement being entirely in accord with modern advanced views. The classification of the diseases rests upon a solid foundation, its basis being pathology. Thus Class I. is "Inflammations," including the exanthemata, eczema, and the numerous other diseases of a manifestly inflammatory or exudating nature usually included by authors in this class. Class II. comprises "Hemorrhages;" Class III. "Hypertrophies;" Class IV. "Atrophies;" Class V. "New Growths;" "Class VI. "Neuroses;" Class VII. "Dis-